XIX. ELOSAURUS PARVUS; A NEW GENUS AND SPECIES OF THE SAUROPODA.

By O. A. Peterson and C. W. Gilmore.

Associated with the large Brontosaur skeleton[1] (No. 563)[2] discovered last summer by the Paleontological Expedition of this museum operating from "Camp Carnegie," on Sheep Creek, Albany Co., Wyo., there was found the remains of a diminutive dinosaur hitherto unknown to science.

Through the kindness of Mr. J. B. Hatcher, Curator of the Department of Vertebrate Paleontology, the material has been placed in the hands of the writers for study and description.

The bones were found scattered over an area of some ten to fifteen feet square and as is the case with all disarticulated skeletons the association of parts is somewhat conjectural. In this instance, however, the association of this small dinosaur with the remains of the larger individual, together with the particularly well preserved condition of the small bones makes it reasonably certain that they pertain to one animal. Moreover in the present instance doubtful bones have been excluded.

In the present paper a systematic description will be given of the material at hand and an attempt made to compare the most important characters with the better known members of this order.

The illustrations are from photographs by Mr. A. S. Coggeshall and drawings by Mr. Sidney Prentice.

We take this occasion to thank Mr. Hatcher for valuable suggestions and criticisms made in the preparation of this paper; Mr. F. A. Lucas for material loaned for comparison, and Prof. W. C. Knight for the use of literature.

[1] See Science, N. S., Vol. XIV, Dec. 27, 1901, p. 1015.

[2] The numbers enclosed in brackets refer to the Card Catalogue of Fossil Vertebrates in the collection of the Carnegie Museum.

Class REPTILIA.

Subclass Dinosauria.

Order Sauropoda.

Family MOROSAURIDÆ.

Genus Elosaurus.

Elosaurus gen. nov.

This genus may be distinguished from all the known Sauropoda by the pubis, which inferiorly is greatly expanded antero-posteriorly with a very prominent backward projection on the extreme posterior border of the distal end. The anterior cervicals have a single square node-like spine. The limb bones are solid.

Elosaurus parvus sp. nov.

The sacral vertebræ of this species are solid with the exception of three small pits extending down into the centra from their superior surfaces. The sacral rib attachments are very broad. The dorsals are comparatively low and massive with a large neural canal. The oblique position of the deltoid crest is characteristic. The proximal end of the ulna is greatly expanded posteriorly. The small size of this individual, together with the sutural articulations of the cervicals and dorsals to their centra, in all probability can not be considered of generic or specific importance, though we have thought best to mention them in this connection.

The type of this genus and species (No. 566) consists of the scapula, humerus, and ulna of the right forelimb and the humerus of the left, the right femur and left fibula of the posterior limbs. The pelvis is represented by the distal end of the right pubis, while part of a cervical and a complete arch of one of the dorsals together with two sacral centra and the proximal ends of three ribs is all that remains of the axial skeleton. The sacral centra, though found in close proximity to the other bones, have a worn appearance in comparison with the otherwise well-preserved material and will, for the present, only be provisionally referred to the type.

Scapula and Forelimb.—Though resembling Morosaurus in general outline the scapula is relatively longer and not so expanded superiorly, though the extent of this expansion cannot be determined accurately as a portion of the antero-superior border is missing. Medially the scapula is constricted. Distally it again expands into a wide plate for contact with the coracoid; externally this plate presents a concave surface terminating in a thin border anteriorly. This border increases in thick-

ness as it approaches the glenoid cavity. Anteriorly throughout its entire length the blade thins out to a sharp edge, while the posterior margin presents a thickened rounded border. There is no prominence on this border near the constriction, such as is found in many scapulæ of the larger Sauropods. Transversely the external surface of the blade

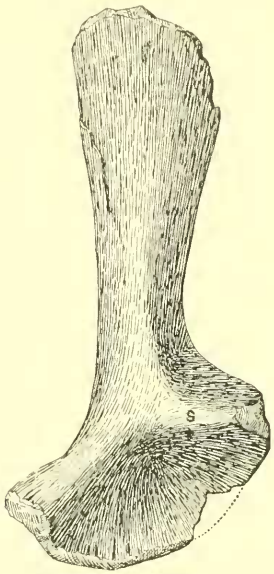

FIG. 1. External view of right scapula of *Elosaurus parvus* (No. 566), ¼ natural size. *S.*, spine.

is convex while the internal is somewhat concave. The spine is placed at right angles to the axis of the bone. The posterior border as it approaches the distal end curves backward abruptly, forming the superior border of the glenoid cavity. In the last two respects the scapula is identical with the typical Morosaurus scapula. The glenoid cavity as in the larger members of this order is formed by the union of the scapula and coracoid though the latter element is wanting in this specimen. See Fig. 1.

MEASUREMENTS.

Greatest length of scapula,	320 mm.	12½ inches.
Greatest breadth of scapula,	150 "	5⅞ "
Least breadth of scapula,	48 "	1⅞ "

Humerus.—The humerus is moderately stout and about two-thirds the length of the scapula. Proximally it is greatly expanded trans-

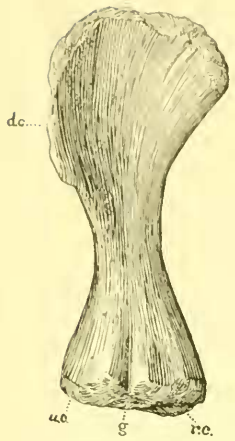

Fig. 2. Anterior view of right humerus of *Elosaurus parvus* (No. 566), ¼ natural size. *u.c.*, ulnar condyle; *r.c.*, radial condyle; *d.c.*, deltoid crest; *g.*, groove separating ulnar and radial condyles.

versely, and superiorly it presents a regularly convex surface, and a well-defined head for articulation with the scapula. The deltoid crest is prominent, but in both humeri it is turned obliquely outward thus forming much less of a concavity on the anterior surface, see Fig. 2, than is found in the humeri of other Sauropoda. Medially the shaft is constricted and a cross-section would be nearly circular. The ulnar condyle has a flat rugose surface while the internal or radial condyle is slightly concave, the two being separated by a well-defined groove on the anterior face. See *g*, Fig. 2.

Measurements.

Greatest length of humerus,	225 mm.	8¾ inches.
Greatest breadth of humerus, proximal end,	104 "	4 1/16 "
Greatest breadth of humerus, distal end,	80 "	3⅛ "

Ulna.—The ulna as in the other Sauropoda is apparently the stouter element of the forearm. On the anterior side the proximal end has a well-defined groove in which the radius fits. See Fig. 3. On the distal internal side is a flattened, slightly rugose surface for the attachment of the radius, which element crosses from the front to the side of the ulna, as has been shown previously by Hatcher[3] and Riggs.[4] Laterally the proximal end is greatly expanded (see Fig. 3), but the ulna tapers down to a somewhat rounded distal extremity. The proximal end of the ulna supports the entire posterior and exterior portions of the humerus, thus enclosing externally and posteriorly the proximal end of the radius, while the radius articulates only with the internal or radial condyle.

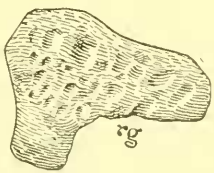

Fig. 3. Proximal end of right ulna of *Elosaurus parvus* (No. 566), one half natural size. *rg*, radial groove.

[3] Hatcher. Forelimb and Manus of Brontosaurus. Annals of the Carnegie Museum, Vol. I, pp. 356 et seq.

[4] Riggs. Foreleg and Pectoral Girdle of Morosaurus, Pub. Field Columbian Museum Geological Series, Vol. I, No. 10, p. 278.

MEASUREMENTS.

Greatest length of ulna,	162 mm.	6⅜ inches.
Greatest thickness of proximal end,	43 "	1⅝ "
Greatest breadth of proximal end,	56 "	2¼ "

Pelvis and Posterior Limbs.—The well-preserved distal portion of the right pubis is all that was recovered of the pelvis, and although it is generically the most characteristic bone preserved, because of its fragmentary condition, a complete description will have to be deferred until the discovery of more perfect material. If our determination be correct the enormous antero-posterior development of the distal end with the backward hook-like extension on the posterior border makes this element distinct from the pubis of any known Sauropod. The shaft was evidently short and broad. Immediately above the distal end the shaft is constricted but the postero-internal border above expands into a thin edge, which probably opposed a similar edge on

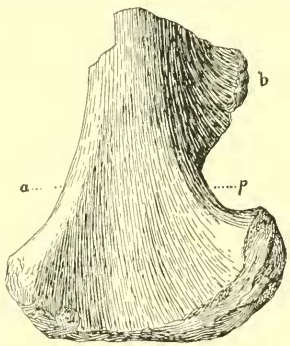

FIG. 4. Internal view of distal end of right pubis of *Elosaurus parvus* (No. 566), one-half natural size. *a*, anterior border; *p*, posterior border; *b*, supposed pubic articulation.

the opposite pubis. Anteriorly the shaft presents a thick rounded border. Externally the distal end is convex; internally slightly concave. The pubes were evidently united distally by a weak median symphysis. See Fig. 4.

MEASUREMENTS.

Greatest breadth of pubis, distal end,	79 mm.	3⅛ inches.
Greatest thickness of pubis, distal end,	27 "	1 1/16 "

Femur.—This element is long and moderately robust with the two ends about evenly expanded. The shaft is compressed antero-pos-

teriorly with that diameter subequal throughout its length. The head of the femur is placed at right angles to the shaft of the bone, in which respect it most resembles the femur of *Diplodocus*.[5] The head is separated from the great trochanter by a slight constriction (see Fig. 5), but blends into the shaft without a well-defined neck.

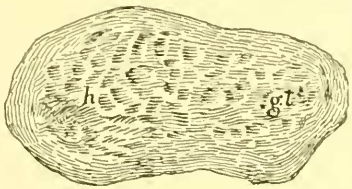

FIG. 5. Proximal end of right femur of *Elosaurus parvus* (No. 566), one-half natural size. *h*, head; *g.t.*, great trochanter.

The fourth[6] trochanter is very small, hardly more than a slight rugosity, placed on the internal margin on the upper half of the posterior side. Distally the femur expands, giving rise to the external and internal condyles, which are separated by a deep intercondylar groove. An external condylar groove divides the external condyle in two parts. See Fig. 6.

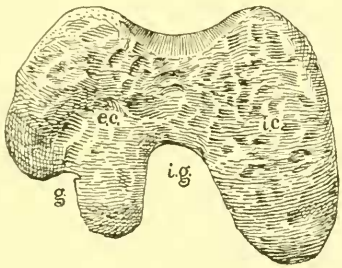

FIG. 6. Distal end of right femur of *Elosaurus parvus* (No. 566), one-half natural size. *e.c.*, external condyle; *i.c.*, internal condyle; *i.g.*, intercondylar groove; *g.*, groove which divides *e.c.* into two parts.

MEASUREMENTS.

Greatest length of femur,	335 mm.	13¼ inches.
Greatest breadth of femur, proximal end,	96 "	3¾ "
Greatest breadth of femur, distal end,	94 "	3⅝ "

Fibula.—The fibula is a long slender bone and presumably much lighter than the tibia. Transversely the diameter of the shaft remains

[5] Hatcher. Memoir of Carnegie Museum, Vol. I, No. 1, p. 47.

[6] Sometimes incorrectly called the third.

about the same throughout its length, but antero-posteriorly it is expanded more especially at the proximal end. The internal side of this end presents a triangular slightly concave rugose surface for attachment to the tibia. The antero-superior border is produced into a thin edge which fitted against the cnemial crest of the tibia. On the upper external half of the shaft is a slight rugosity which probably served as a muscular attachment. The lower extremity of the fibula is suboval in form and extended distally for articulation with the astragulus.

MEASUREMENTS.

Greatest length of the fibula,	243 mm.	$9\frac{1}{2}$ inches.
Greatest breadth proximal end,	56 "	$2\frac{3}{16}$ "
Greatest breadth of distal end,	43 "	$1\frac{5}{8}$ "

AXIAL SKELETON.

The Cervicals.—The greater portion of an arch of one of the anterior cervicals is all that is preserved of the cervical series. In a general way it resembles the cervical arch of the larger members of this group. The arch was united to the centrum by a well-defined suture. The spine is low and robust, nearly square in cross-section and placed well back.

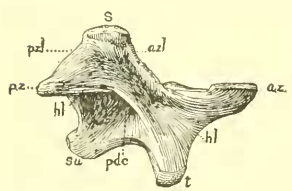

FIG. 7. Anterior cervical of *Elosaurus parvus*. Seen from the right side (No. 566), ½ natural size. *s.*, spine; *t.*, transverse process, or diapophysis; *a.z.*, anterior zygapophysis; *p.z.*, posterior zygapophysis; *azl.*, prezygapophysial lamina; *pzl.*, postzygaphysial lamina; *hl.*, horizontal lamina; *pdc.*, postdiapophysial cavity; *su.*, suture to centrum.

The articulating surfaces of the posterior zygapophyses are expanded. Superiorly they are supported by the postzygapophysial[7] laminæ which descend from the adjacent posterior corner of the spine. These laminæ are strong superiorly but inferiorly form the rather frail posterior wall of the neural canal. There is a deep postzygapophysial cavity.[8] The prezygapophysial laminæ are very weak superiorly but more robust inferiorly, just the reverse of the postzygapophysial laminæ. The horizontal laminæ descend obliquely from the post- and prezygapophyses meeting in the diapophyses. The diapophysis or transverse process is low on the arch and extends downward, forward and outward, terminat-

[7] We have used nomenclature for laminæ proposed by Dr. H. F. Osborn, see Memoir of Am. Museum of Natural History, Vol. I, part V, p. 193.

[8] Nomenclature for cavities was proposed by Mr. J. B. Hatcher, Memoir Carnegie Museum, Vol. I, No. 1, July, 1901, p. 17.

ing in a triangular end to which the cervical rib probably attached though there are no other evidences of the latter. This process is supported inferiorly by the inferior blade of the diapophysial lamina. The superior blade is absent. Of the diapophysial cavities the post- is the most pronounced, the pre- and supra- being very shallow, while the infradiapophysial cavity is wanting. See Fig. 7.

MEASUREMENTS.

Greatest length anterior to posterior zygapophyses,	60 mm.	2⅜ inches.
Top of spine to inferior border of neural arch,	35 "	1⅜ "

The Dorsals.—The presence of the heavy capitular facets situated far down on the anterior border of the neural arch, together with the presence of a single spine would indicate that this vertebra belonged well back in the dorsal series. The spine which wants the superior portion has a posterior position. The superior blades of the postzygapophysial laminæ are very heavy while the inferior are of weaker construction and descend to form the posterior walls of the neural canal. The transverse processes are well expanded and extend upward and forward as shown in Figs. 9 and 10. The tubercular facet is much restricted in comparison with the extended capitular articulation. The diapophyses are supported superiorly by very weak diapophysial laminæ; inferiorly these laminæ divide into two branches, one part descending obliquely backward to a point half way down on the neural arch, while the weaker branch[9] meets the heavy prezygapophysial laminæ just above the capitular facet, as is shown in Fig.

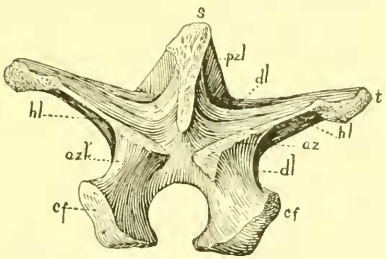

FIG. 8. Dorsal of *Elosaurus parvus*. Anterior view (No. 566), one half natural size. *s.*, spine; *azl.*, prezygapophysial lamina; *pzl.*, postzygapophysial lamina; *hl.*, horizontal lamina; *dl.*, diapophysial lamina; *t.*, transverse process; *a.z.*, anterior zygaphophysis; *c.f.*, capitular facet.

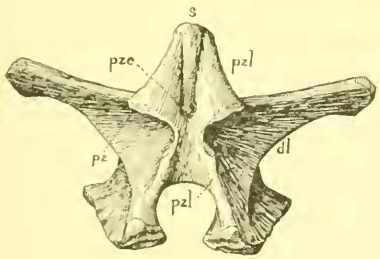

FIG. 9. Posterior view of same (No. 566). One half natural size. *p.z.*, posterior zygapophysis.

[9] If the complete dorsal series were known so that the development of the laminæ could be traced, this branch might prove to be a division of the horizontal laminæ as shown by Hatcher in his description of the dorsals of *Diplodocus*.

10. The horizontal laminæ extend almost horizontally from the pre- to the postzygapophyses meeting in the transverse processes. The inferior blades of the prezygapophysial laminæ are remarkably heavy, but the superior portion is wanting. The neural arch is comparatively large and nearly round. In general the arch has a low massive appearance like the transverse extension observed in Morosaurus. The arch was united to the centrum by a very coarse sutural articulation. Of the cavities all four of the diapophysial cavities are present, the pre- and post- being the most pronounced. The infrazygapophysial cavity is comparatively shallow. See Fig. 10.

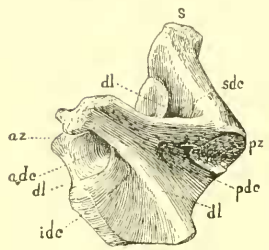

FIG. 10. Dorsal of *Elosaurus parvus*, seen from left side (No. 566), ½ natural size. *sdc.*, supradiapophysial cavity; *pdc.*, postdiapophysial cavity; *adc.*, prediapophysial cavity; *idc.*, infradiapophysial cavity.

MEASUREMENTS.

Greatest length from anterior to posterior zygapophyses,	57 mm.	$2\frac{3}{16}$ in.
Greatest expanse from end to end of transverse,	99 mm.	$3\frac{7}{8}$ in.

Sacrum.—The two sacral centra, which have been provisionally referred to this specimen are short, broad and comparatively solid, much resembling the sacral vertebræ of *Pleurocœlus nanus*.[10] Both ends of the centra are flat and there is no evidence of their having been coössified, though the absence of this character may be due to the young age of the individual. The attachments for the sacral ribs are very broad, extending over nearly the entire sides of the centra. Superior to the rib attachments are two pits extending down obliquely toward the center of the centrum. These pits are more pronounced on No. 1 [11] than on No. 2. Inferiorly the neural canal at this point is enlarged by peculiar wedge-shaped pits which extend deep down into the centra. It is observed in both instances that the lateral dimensions are much greater than the longitudinal.

MEASUREMENTS.

	No. 1.		No. 2.	
Greatest length of centra,	72 mm.	$2\frac{7}{8}$ in.	68 mm.	$2\frac{5}{8}$ in.
Greatest width of centra,	88 mm.	$3\frac{1}{2}$ in.	98 mm.	$3\frac{7}{8}$ in.
Greatest depth of centra,	61 mm.	$2\frac{3}{8}$ in.	67 mm.	$2\frac{5}{8}$ in.

[10] Marsh, see American Journal of Science, Vol. XXXV.

[11] These numbers are used to designate the vertebræ and have no reference to their position in the sacrum.

Summary.—Awaiting the discovery of a more complete skeleton of this genus, we have provisionally referred it to the family *Morosauridæ* because of the stout nature of the pubis; the similarity of the proximal portion of the scapula to the scapula of *Morosaurus*, and the comparatively solid condition of the sacral centra.

There is little to be said of the size of this animal, for, as has been already suggested, like most reptiles the Sauropoda probably continued to grow throughout their entire life. Though all parts of the osseous structure of this individual, which are preserved, are of comparatively dense bone, the immature age of the specimen cannot be questioned. The distinct neural sutures in the cervical and dorsal region, the separated sacrals, and the absence of the coracoid all indicate a comparatively young animal. By comparison of the fore and hind limbs (Plate XXV, Figs. 1 and 2) it will be observed that the fore limb is about two-thirds the length of the posterior, indicating a type whose movement on land was undoubtedly quadrupedal.

Carnegie Museum,
May 1, 1902.